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Mesosynthesis of ZnO−Silica Composites for Methanol Nanocatalysis

S. Polarz,*,† F. Neues,‡ M. W. E. van den Berg,‡ W. Grünert,‡ and L. Khodeir‡

Contribution from the Technical University Berlin, Institute of Chemistry, Strasse des 17, Juni 135, 10623 Berlin, Germany and Ruhr-University Bochum, Universitaestr. 150, 44780 Bochum, Germany

Received March 15, 2005; Revised Manuscript Received July 11, 2005; E-mail: sebastian.polarz@tu-berlin.de.

Abstract: Methanol catalysis meets chemistry under confined conditions. Methanol is regarded as one of the most important future energy sources. ZnO/Cu composite materials are very effective in heterogeneous catalysis for methanol production due to the so-called strong metal−support interaction effect (SMSI). Therefore, materials of superior structural design potentially representing model systems for heterogeneous catalysis are highly desired. Ultimately, such materials could help to understand the interaction between copper and zinc oxide in more detail than currently possible. We report the preparation of nanocrystalline, size-selected ZnO inside the pore system of ordered mesoporous silica materials. A new, liquid precursor for ZnO is introduced. It is seen that the spatial confinement significantly influences the chemical properties of the precursor as well as determines a hierarchical architecture of the final ZnO/SiO_2 nanocomposites. Finally, the ability of the materials to act as model systems in methanol preparation is investigated. The materials are characterized by a variety of techniques including electron microscopy, X-ray scattering, solid-state NMR, EPR, EXAFS, and Raman spectroscopy, and physisorption analysis.